

NOTE: The author of this presentation designed these PowerPoint slides to accompany a verbal presentation; these slides were not designed to be a stand alone presentation. The verbal presentation is not available.

Abundance and Calving Index of Cook Inlet beluga whales

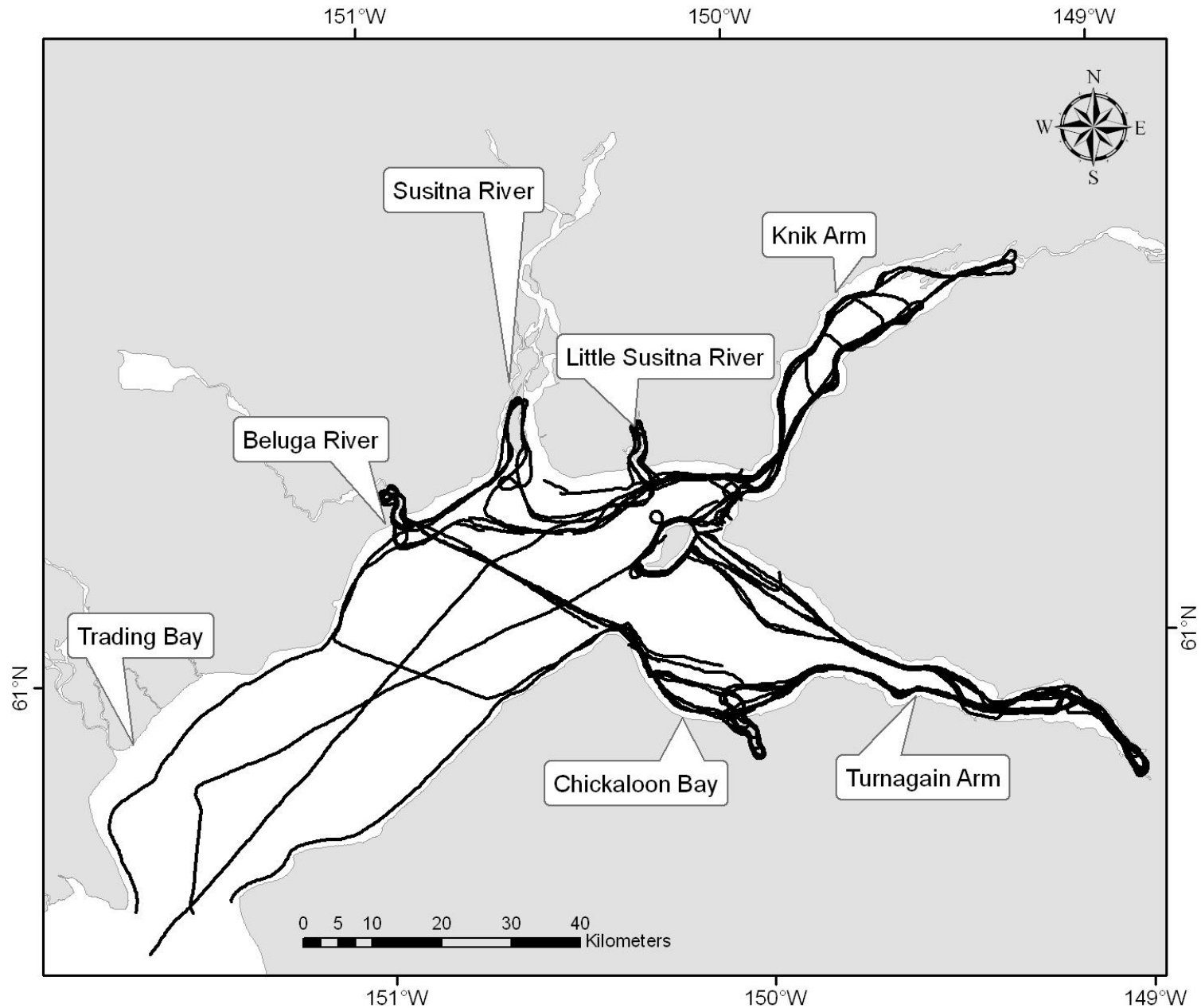
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Service, 7600 Sand Point Way, NE,
Seattle, WA 98115

June 1994-2010 Cook Inlet surveys

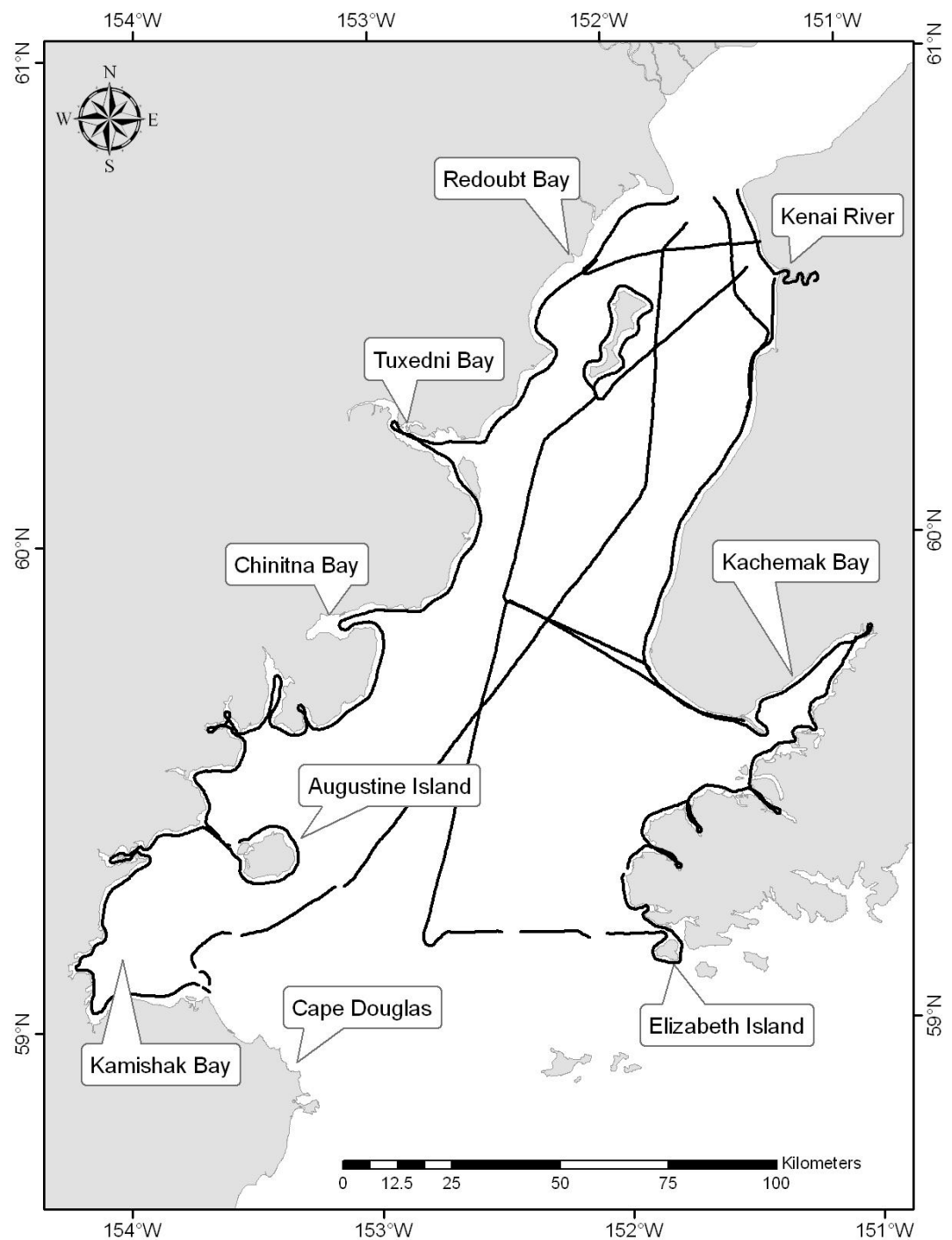
- Aerial survey project: First and second weeks of June
- Aerocommander Aircraft (two years with NOAA Twin Otter aircraft) high wing with bubble windows.
- Three to six complete surveys of upper Cook Inlet (i.e., covering the entire upper inlet coastline during one day)
- Two flights covering lower Cook Inlet
- typical number of groups seen per day: 4-12

2010 Aerial surveys of upper Cook Inlet



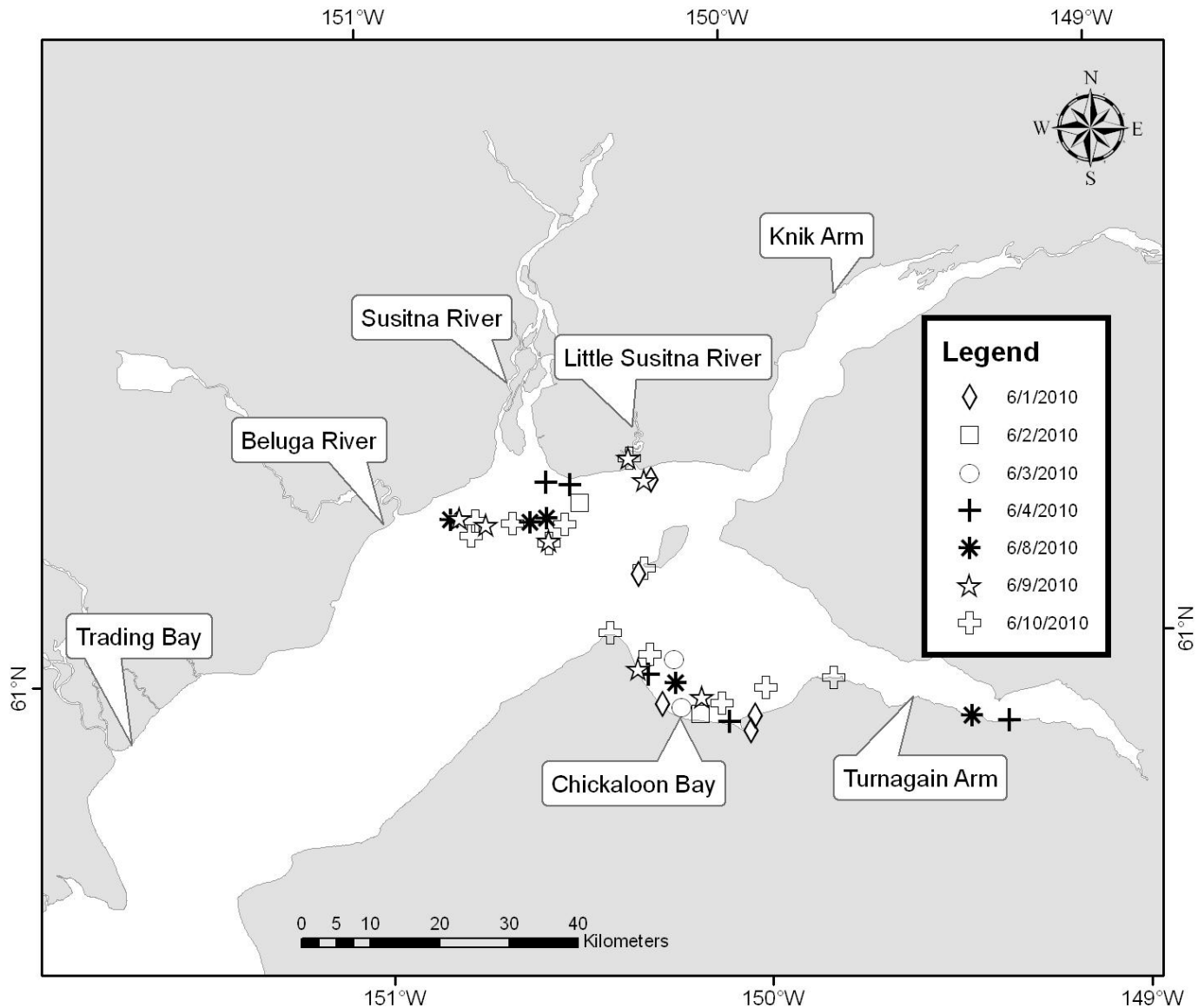
2010 Aerial surveys of lower Cook Inlet

(black lines indicate
flight paths)



Beluga sightings June 2010

(total sightings from all 7 surveys – no belugas were seen in lower Cook Inlet)



Belugas in upper Cook Inlet as seen from the air.

Once a group is found it is circled and counted 4-10 times to get multiple counts and video records.



How many belugas are in that group?



tidal mudflat

silty water

6

1

1

Two independent observers search simultaneously for whales and whale groups

Video data and analyst counts

- A wide angle video records the entire group
- A zoomed video records a sub sample of the group
- Two analysts count whales independently from video records
- 4-8 passes of a group result in 4-8 video records of the group and 8-16 counts of the group by analysts

Paired wide angle and zoomed video cameras provide a consistently nested view of the entire beluga group and a high resolution sub sample of the group



Collecting video



Counting video, view from the air: Dots in motion



Computer-enhanced counts of belugas from video data: repeatable and documented

1Jun05 g1p2.mov : 1Jun05 g1p2 data : 16.205

Click Location of Whale
[&] to change size
Press 'x' to Set

☐ Play 1/2 Speed

Scan Times (M)ag Add (N)ote

(L)oad Movie (S)ave Data

Load (D)ata (Q)uit

| # | Color | Size | Zoom |
|------|-------|---------|------|
| 21 | 1,1,0 | 10,11,0 | 0,0 |
| (20) | 0,0,0 | 0,0,0 | 0,0 |
| 19 | 1,1,0 | 10,9,0 | 0,0 |
| (18) | 0,0,0 | 0,0,0 | 0,0 |
| (17) | 0,0,0 | 0,0,0 | 0,0 |
| 16 | 2,2,0 | 5,5,0 | 0,0 |
| (15) | 0,0,0 | 0,0,0 | 0,0 |
| (14) | 0,0,0 | 0,0,0 | 0,0 |
| (13) | 0,0,0 | 0,0,0 | 0,0 |
| (12) | 0,0,0 | 0,0,0 | 0,0 |
| 11 | 2,2,0 | 6,5,0 | 0,0 |

(#)=Off-Screen

Surveyor 1: cls ☐

Surveyor 2: ktg ☐

Zoom Send to Excel

(U)ndo

Start: 13.853 Change

Stop: 14.891 Change

(M)idpoint Remove Move Label

☐ Off-Screen ☐ Zoom

back 4 frames

beluga HD

beluga 2005 video

IPY.doc Beluga_Archive

positional BRugs

Contribution.doc

PATOB_Canada.doc Christy Beluga wo

Screen from software for beluga video analysis



Screen from software for beluga video analysis

14Jun2006 G7P4.mov : 14Jun2006 G7P4.txt : 30.4226

Ready

☐ Play 1/2 Speed

Scan Times (M)ag

(L)oad Movie (S)ave Data

Load (D)ata (Q)uit

| # | Color | Size | Zoom |
|----|-------|-------|------|
| 62 | 0.0.0 | 0.0.0 | 0.0 |
| 61 | 2.0.0 | 6.0.0 | 0.0 |
| 60 | 2.0.0 | 5.0.0 | 0.0 |
| 59 | 2.0.0 | 6.0.0 | 0.0 |
| 58 | 1.0.0 | 6.0.0 | 0.0 |
| 57 | 2.0.0 | 5.0.0 | 0.0 |
| 56 | 1.0.0 | 6.0.0 | 0.0 |
| 55 | 1.0.0 | 6.0.0 | 0.0 |
| 54 | 2.0.0 | 6.0.0 | 0.0 |
| 53 | 2.0.0 | 5.0.0 | 0.0 |
| 52 | 2.0.0 | 7.0.0 | 0.0 |

(#)=Off-Screen

Surveyor 1: cls ☒

Surveyor 2: ☐

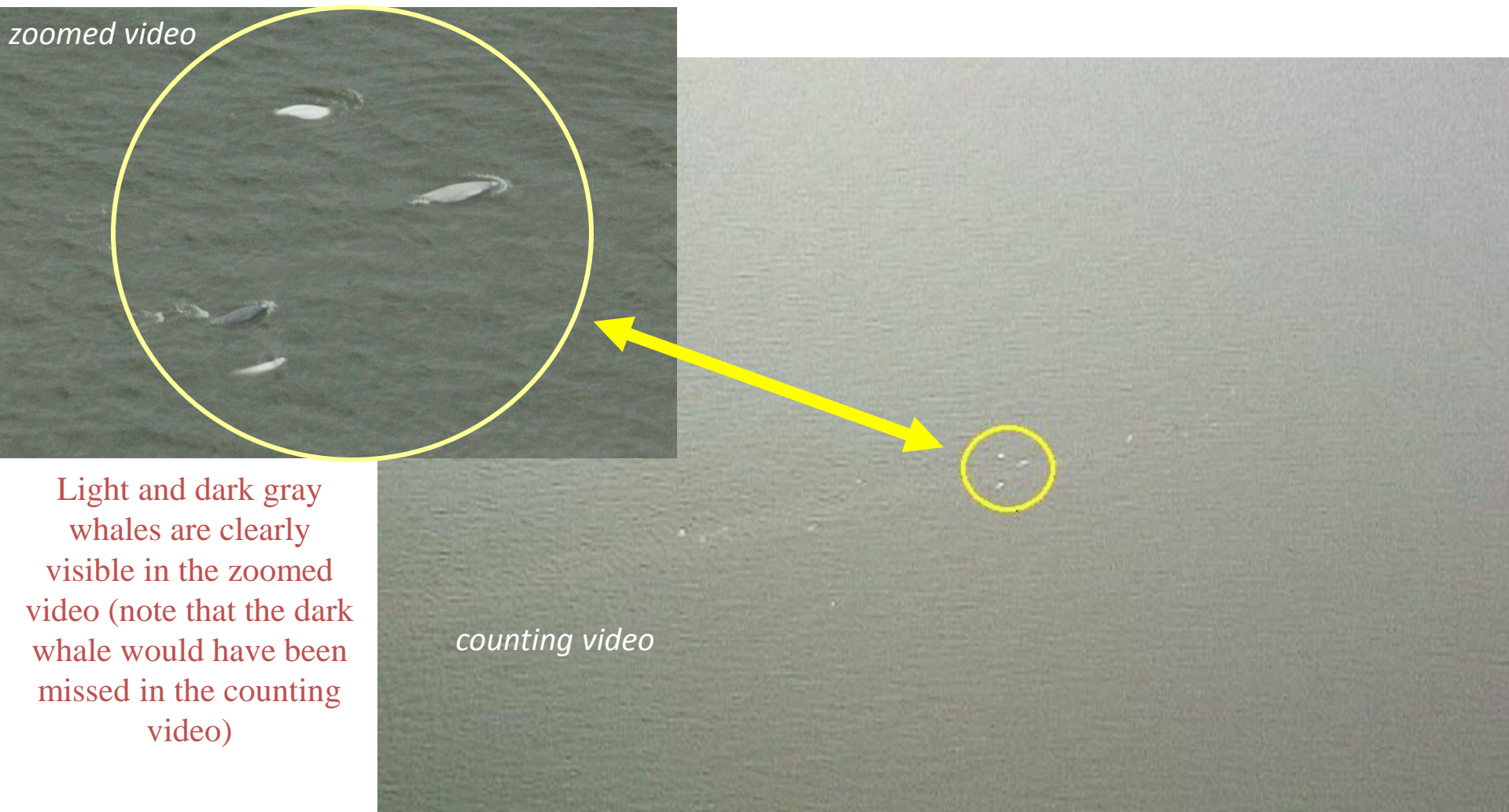
Zoom Send to Excel (U)ndo

Zoomed Analysis:

Correction factors and calf detection



Images from zoomed video are compared to the counting video to determine the fraction missed due to image size



Light and dark gray whales are clearly visible in the zoomed video (note that the dark whale would have been missed in the counting video)

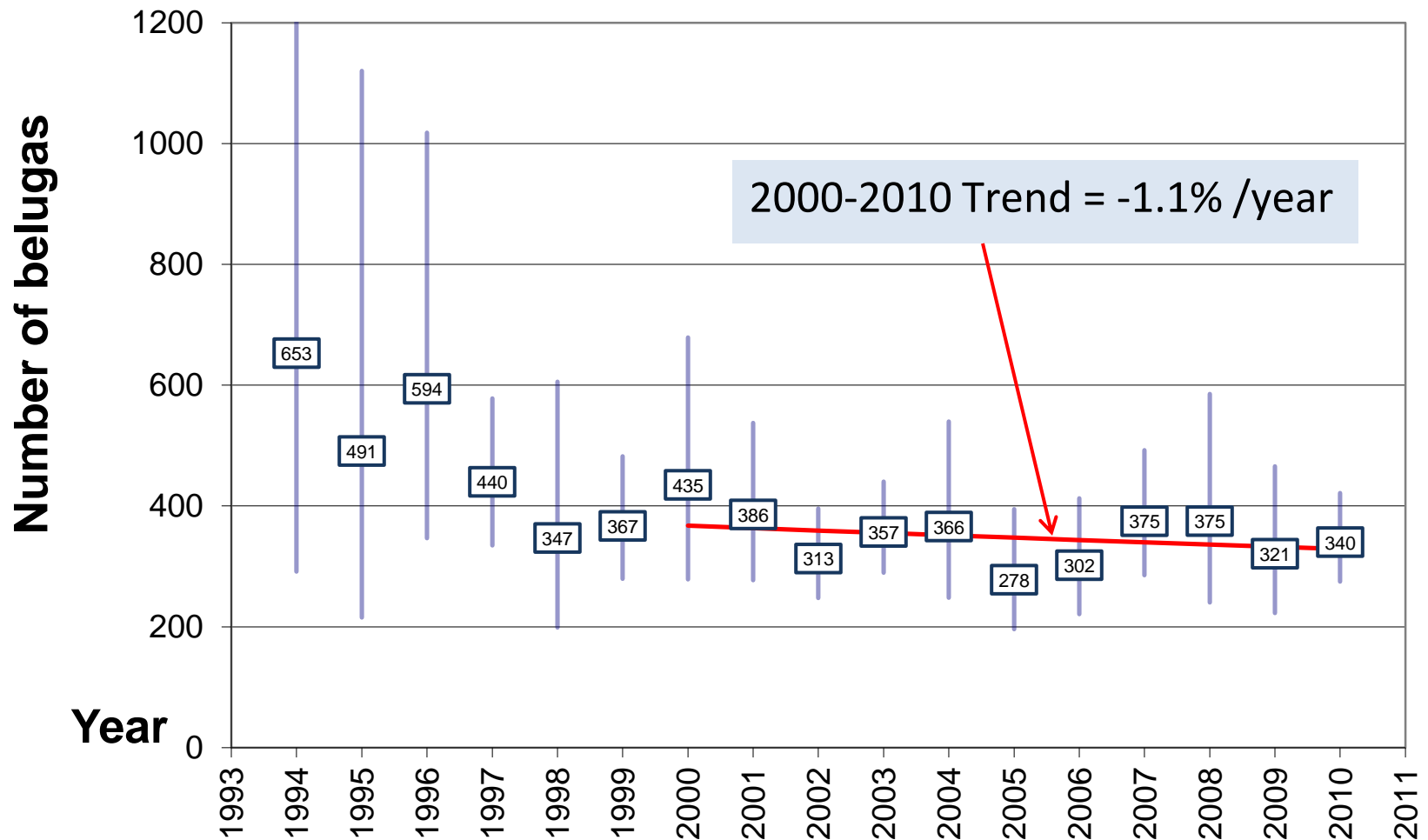
Missed whales

- Missed due to image size (Correction from zoomed video)
- Missed due to submersion (Correction from surface and dive data and scan time)
- Missed group in survey area (Correction from dual independent observer data)
- Missed group outside survey area (survey day not used in estimate)

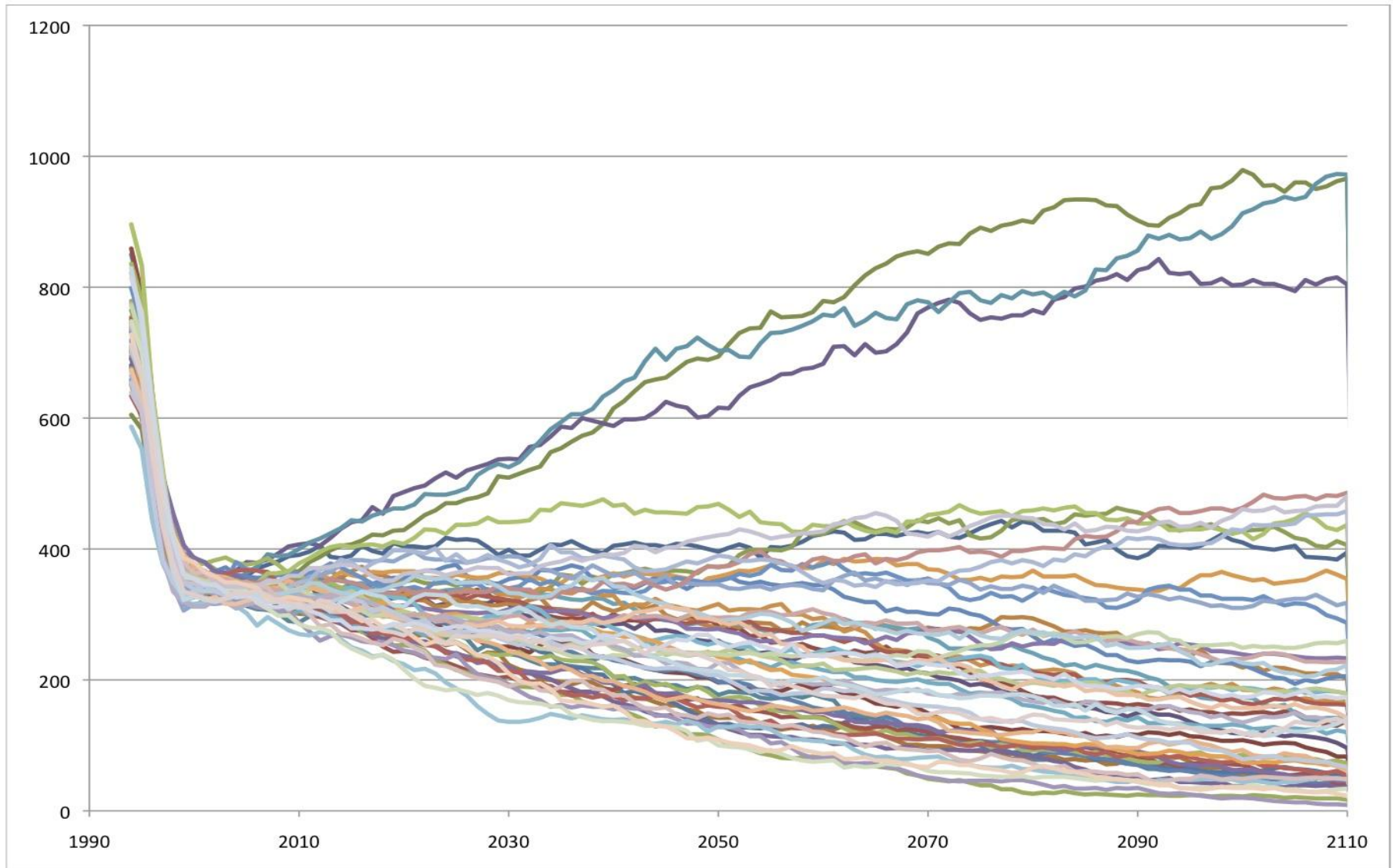
Abundance estimate

- 1994-2002 Abundance summed by day and days averaged for three survey areas: Susitna-Knik, Chickloon-Turnagain, Southern inlet.
- 2003-2010 Abundance summed by day and days averaged for Northern inlet as a unit, no sightings in Southern inlet.
- Survey days that are deemed to be not representative of the population (e.g. incomplete survey or missing groups) are excluded.

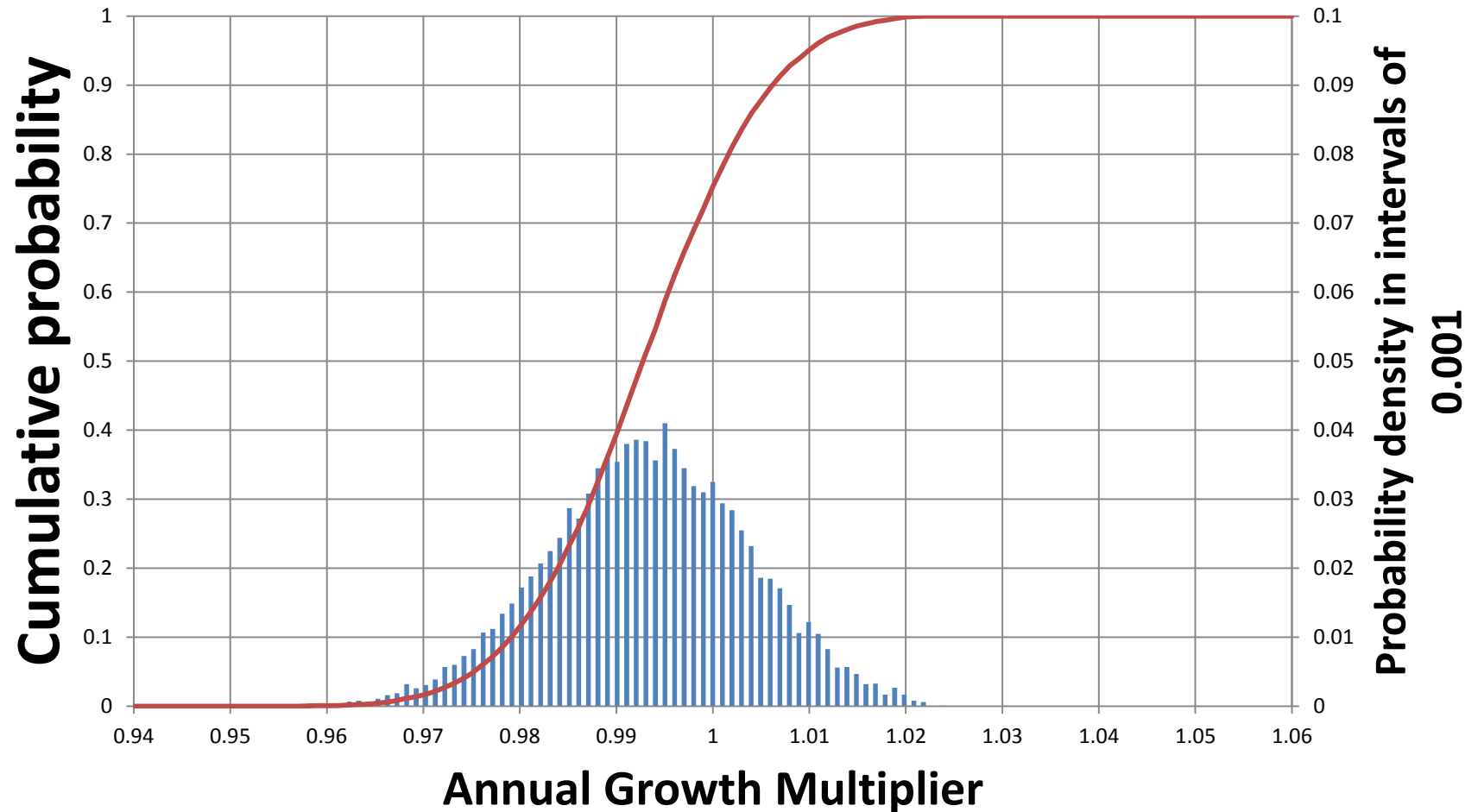
Abundance 1994-2010



PVA Results



Distribution of Average Annual Growth or Decline

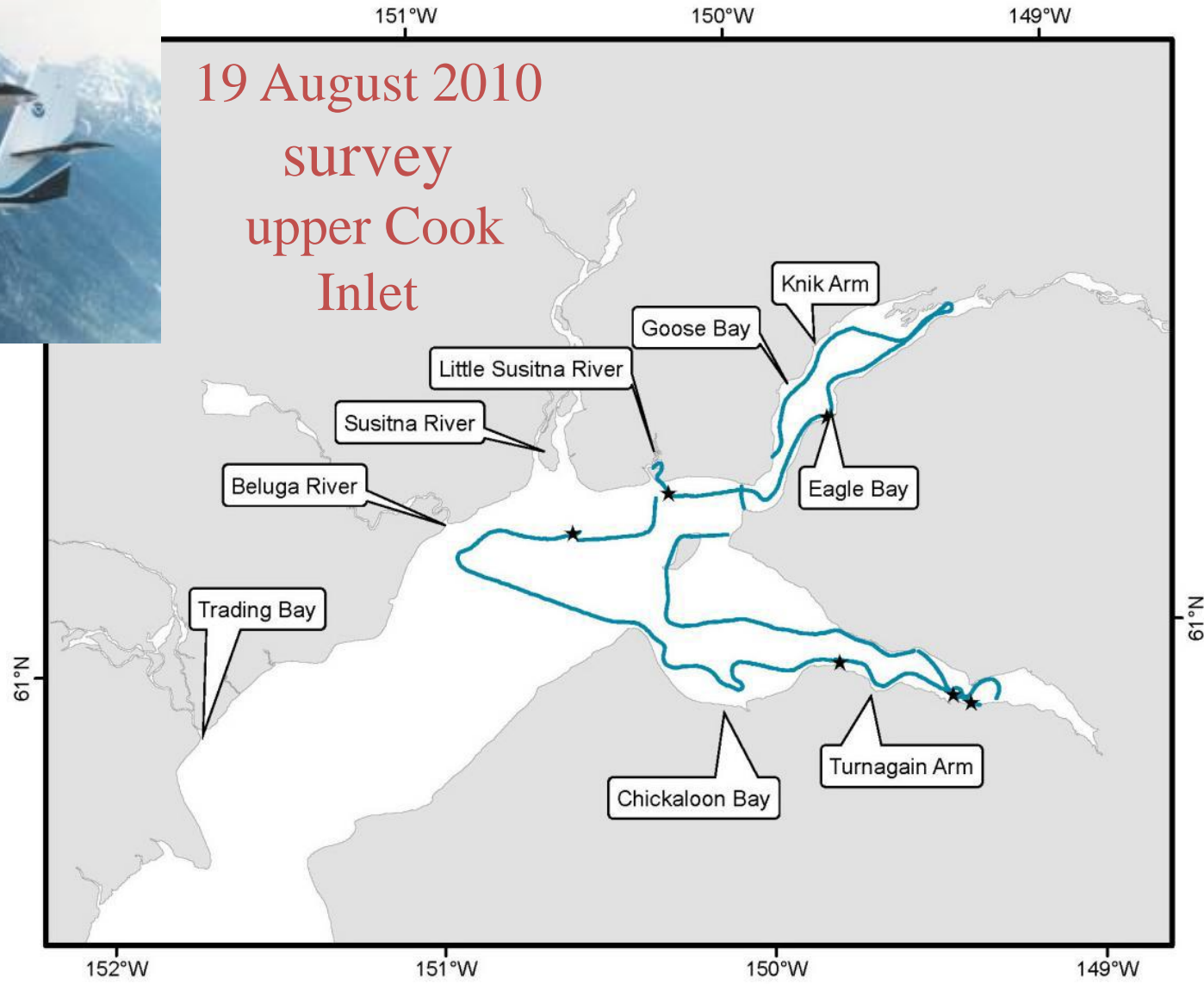


Calf Counts



Blue lines indicate
flight paths

Black stars indicate
groups

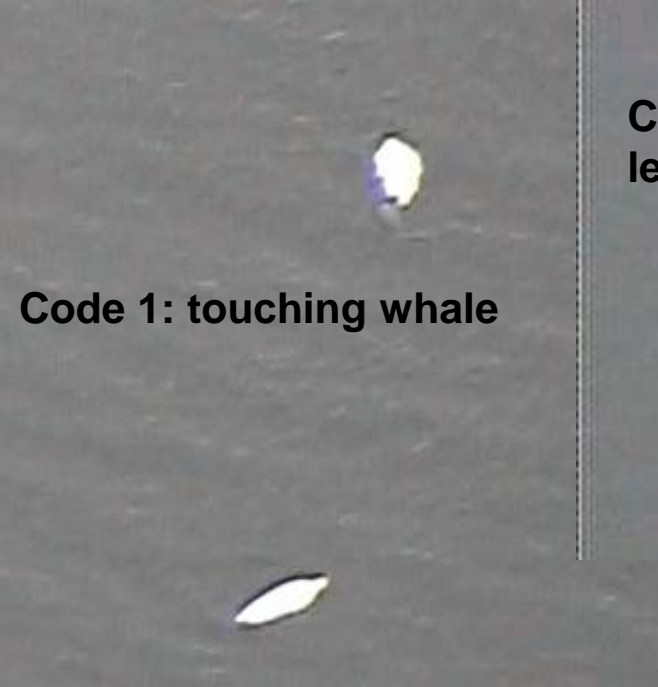


Clues that an image represents a calf

- Image size: Calf length is $\frac{1}{3}$ to $\frac{2}{3}$ of adult length. View angle oblique and only portion above surface visible.
- Image color: Usually dark gray but light color calves are seen and dark juveniles and young adults have been seen.
- Proximity to adult: Young of the year calves are closely associated with adults.

Beluga Colors





Code 1: touching whale



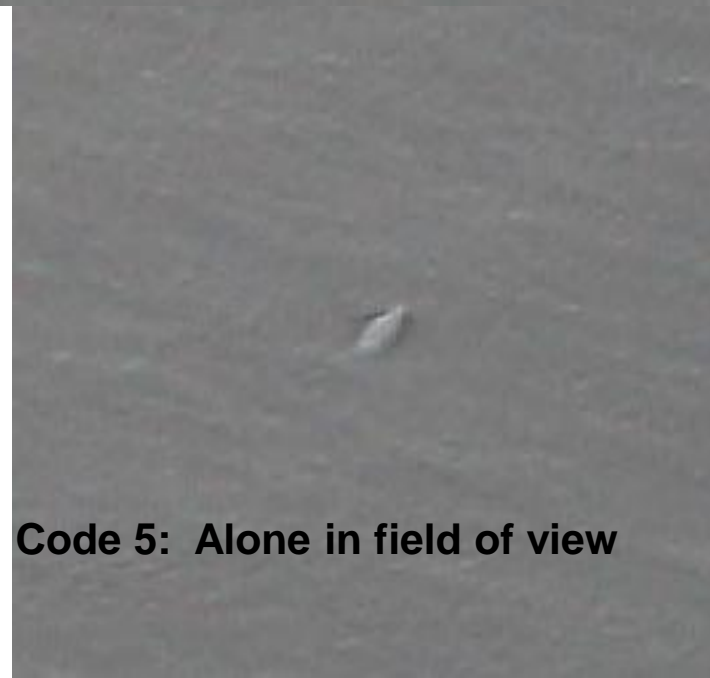
Code 2: 1 whale length apart



Code 3: 2-3 whale lengths apart



Code 4: In same field of view

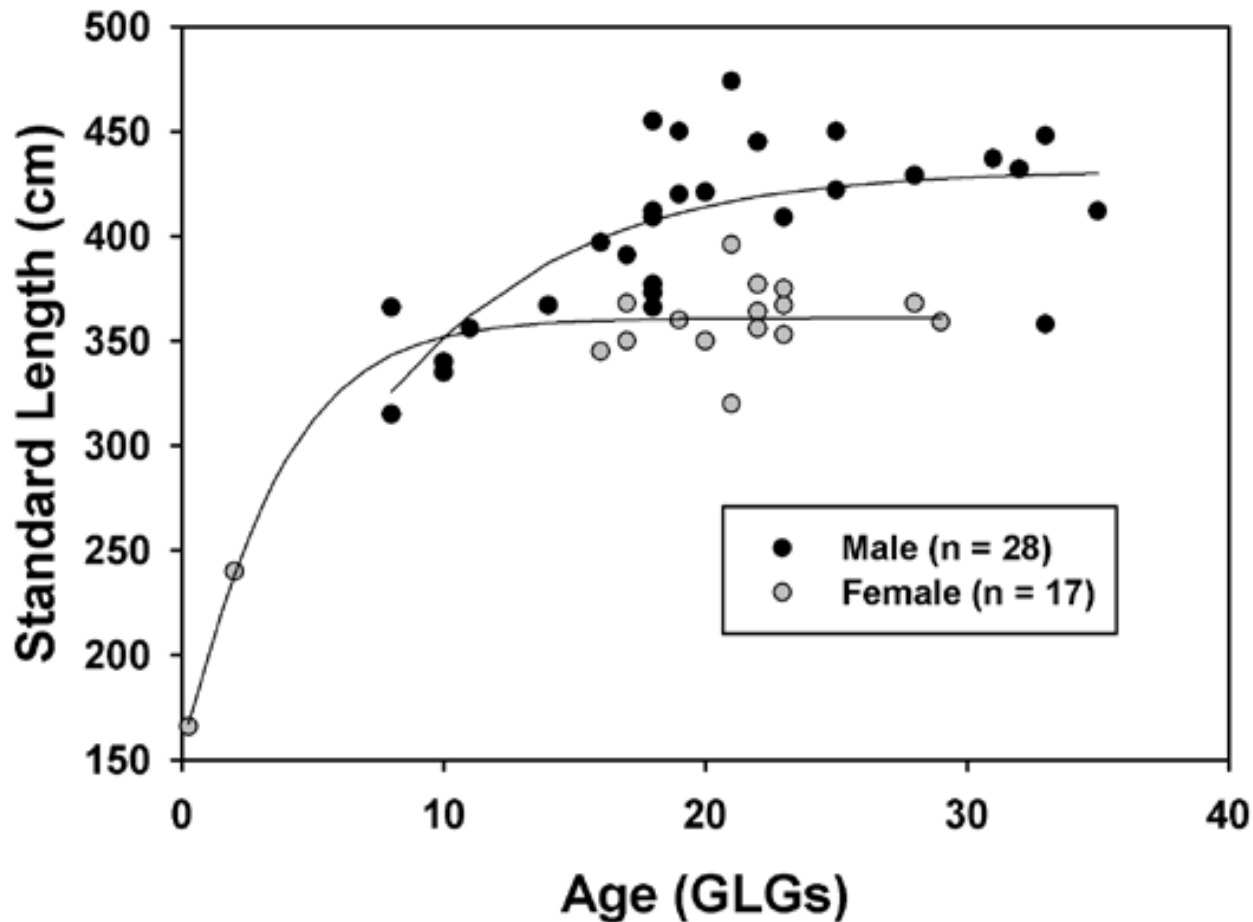


Code 5: Alone in field of view

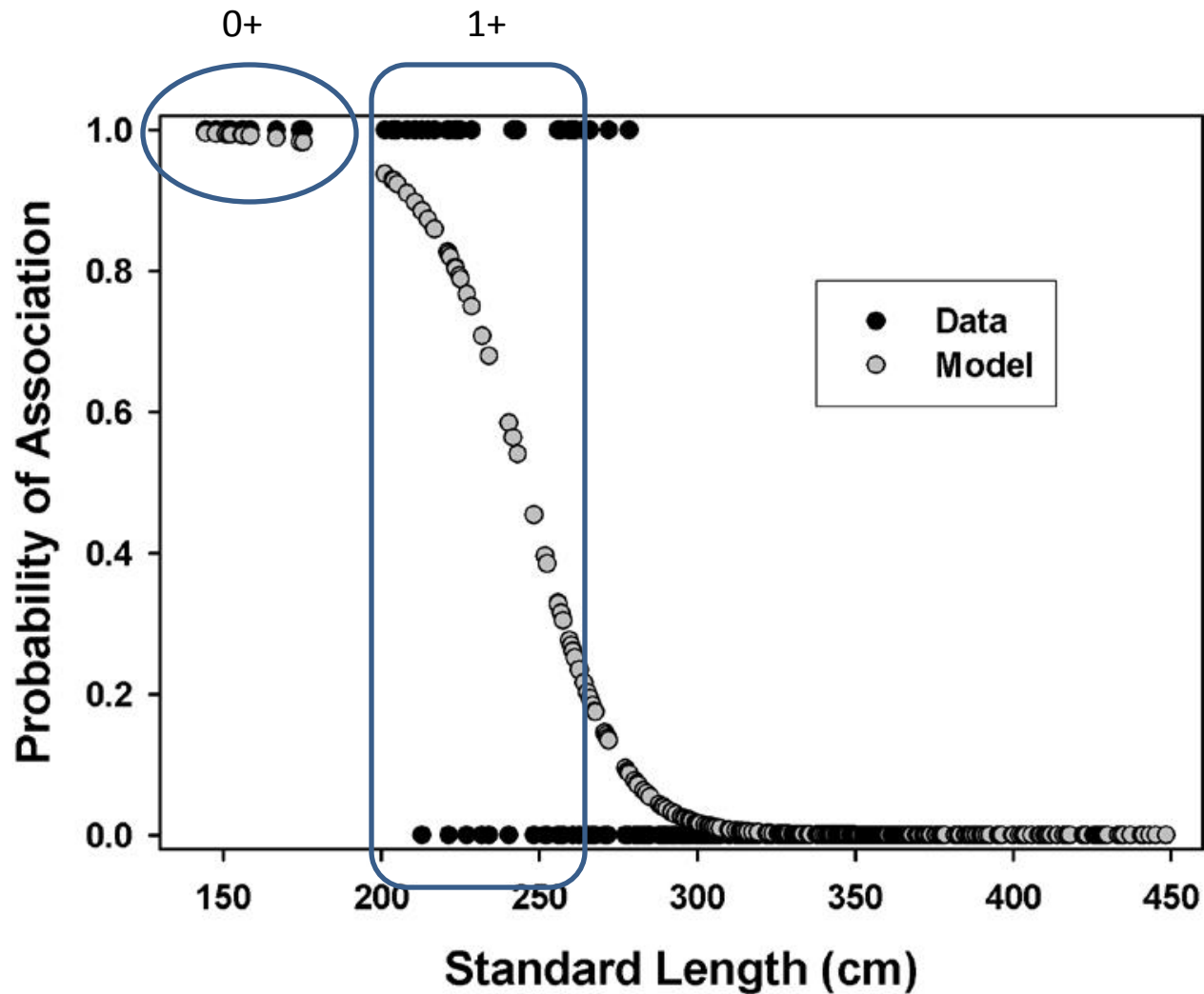
Images analyzed

| Year | Sum of calves | Sum of noncalves | Total |
|-------------|---------------|------------------|-------|
| 2005 | 3 | 228 | 231 |
| 2006 | 18 | 221 | 239 |
| 2007 | 109 | 1021 | 1130 |
| 2008 | 68 | 294 | 362 |
| 2009 | 65 | 603 | 668 |
| Grand Total | 263 | 2367 | 2630 |

Gompertz growth curves for male and female belugas whales sampled in Cook Inlet (Suydam 2008)



Probability by length that a calf in the eastern Chukchi Sea stock will be associated with an adult (Suydam 2008)



Remaining Pieces of the Puzzle

Mother and calf behavior

- Does the mother change her surfacing behavior to accommodate the calf? To some extent when the calf is less than a month old.
- Does the mother bring the calf to the surface to breath without surfacing herself? Yes.
- How does this change with the age of the calf? In the first month a calf will surface every 5-6 seconds on average by three months of age it is breathing with the mother for the most part.

Why an index?

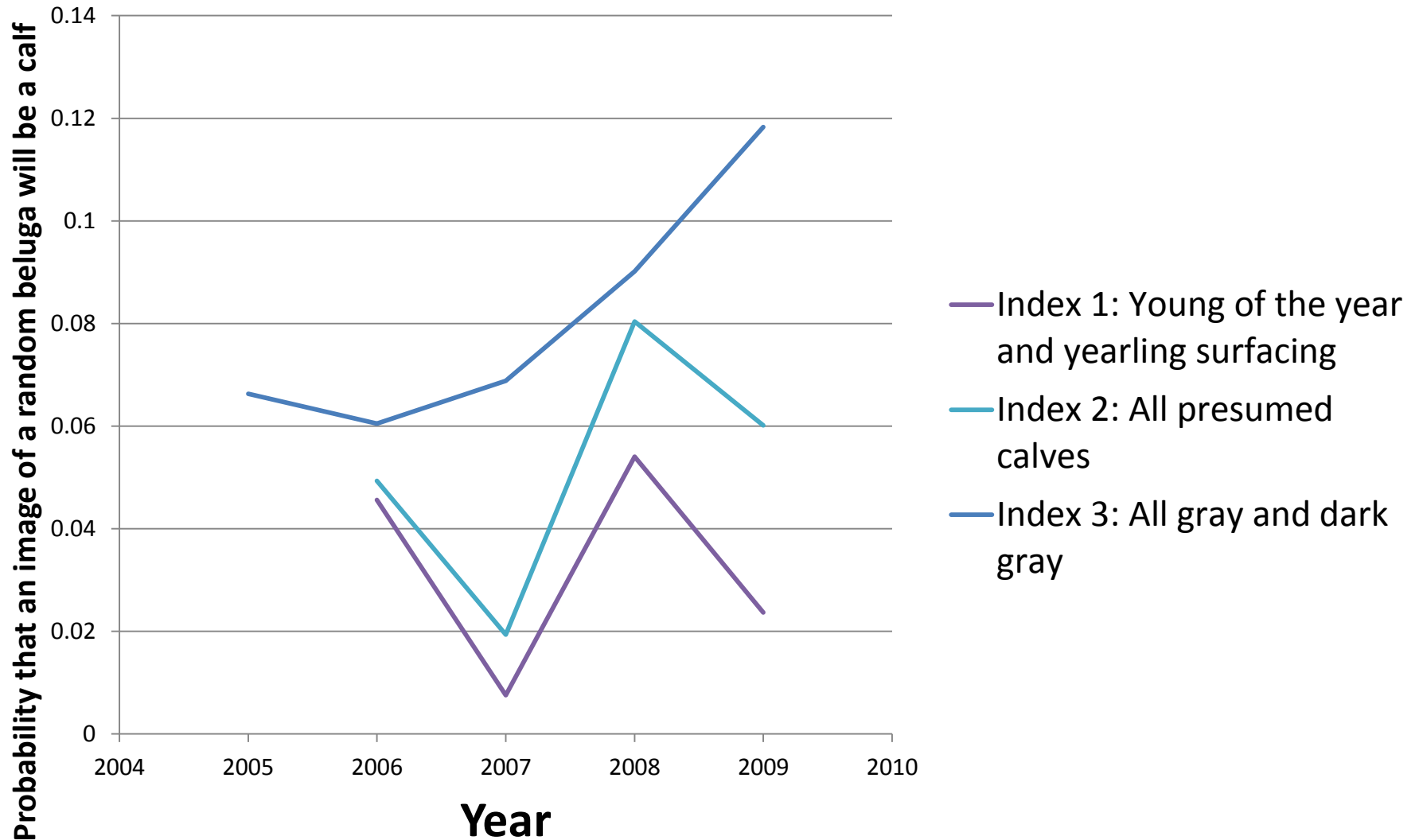
- Secchi depth in Cook Inlet <10 cm (4 in.) so belugas are only visible at the surface.
- Surfacing interval of adults with calves and of calves are not quantified. Less than adults without calves but changing as the calf ages.
- Calves will also surface while the mother remains submerged, so there is not a direct correspondence between calves and adults.

| | Estimated size (cm) from 361 cm white adult | | Age (yr.)estimated from Gompertz growth curve for Cook Inlet beluga females | |
|--|---|--------|--|--------|
| Month | June | August | June | August |
| Calf touching Adult | 218 | 199 | 1.5 | 1.0 |
| Calf within one body length of Adult | 218 | 255 | 1.4 | 2.5 |
| Calf two to three body lengths from Adult | 249 | 246 | 2.3 | 2.2 |
| Calf in same frame as Adult | 233 | 235 | 1.9 | 1.9 |
| Calf alone in view | 318 | 181 | 5.4 | 0.6 |
| Gray belugas considered not to be calves | 296 | 302 | 4.1 | 4.4 |

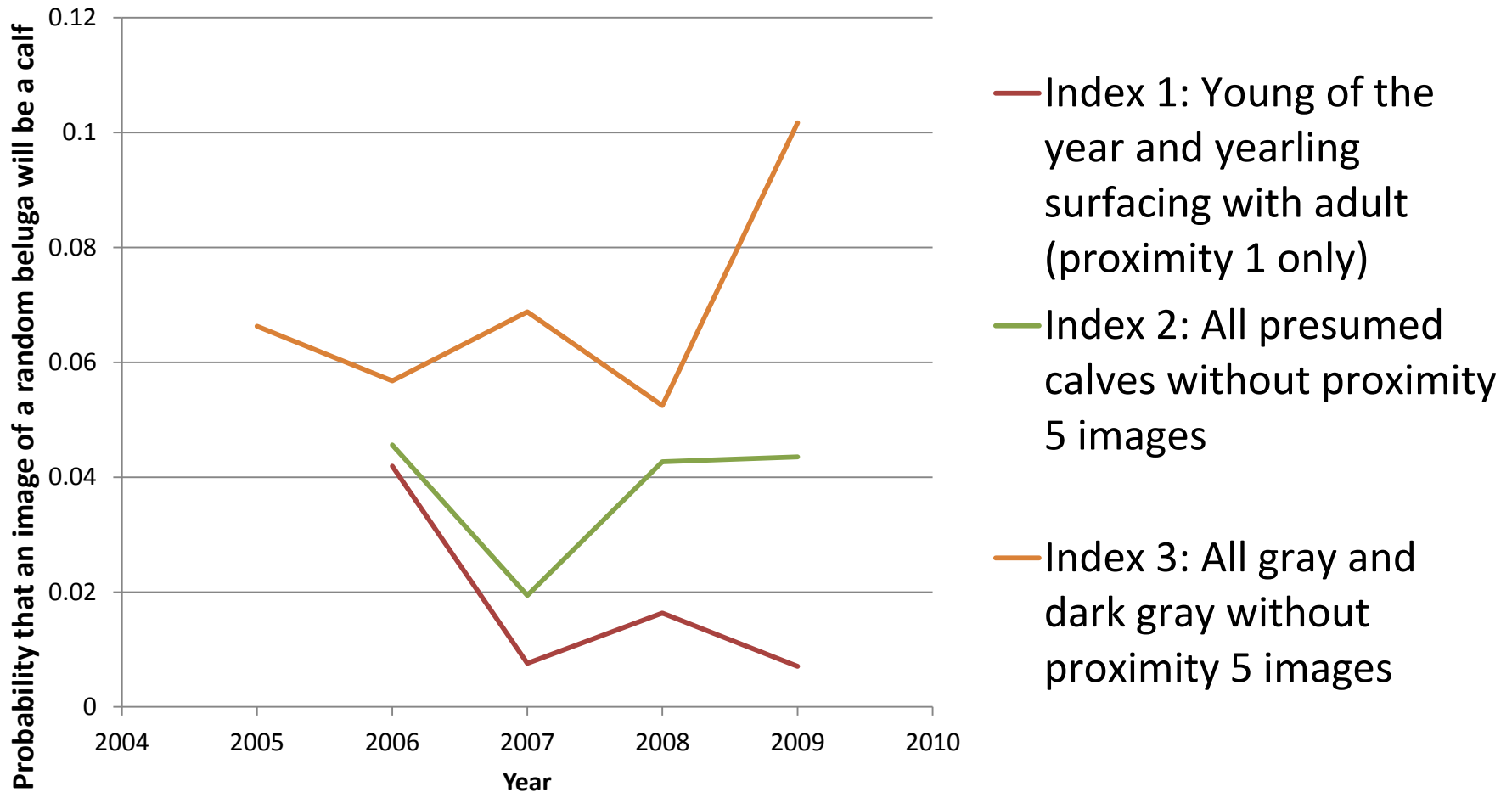
Number of presumed calf images by proximity and year

| Year | 2006 | 2007 | 2008 | 2009 |
|---|------|------|------|------|
| Calf touching Adult | 3 | 5 | 5 | 3 |
| Calf within one body length of Adult | 0 | 3 | 5 | 3 |
| Calf two to three body lengths from Adult | 1 | 2 | 2 | 3 |
| Calf in same frame as Adult | 0 | 7 | 1 | 5 |
| Calf alone in view | 1 | 0 | 2 | 3 |

Annual probability rates for the three proposed indices



Annual probability rates for the three proposed indices when the images of small calves surfacing alone in the field are removed from the analysis



Thank you

